

Conference papers

Generating information from electronic patient records in general practice: a description of clinical care and gender inequalities in coronary heart disease using data from over two million patient records

Pete Horsfield BM BS
Clinical Director

Sheila Teasdale MMedSci CompBCS
Service Director

Primary Care Information Services (PRIMIS), Division of Primary Care, University of Nottingham, UK

ABSTRACT

Objectives To describe the epidemiology of coronary heart disease (CHD) in England and the activity of primary healthcare teams in managing patients with CHD, and also to demonstrate the utility of computerised patient records in providing access to epidemiological data and data reflecting healthcare activity.

Design A descriptive survey of CHD and related clinical data, recorded using computerised clinical records, entered by primary healthcare teams. Aspects reported include prevalence of CHD, together with additional data reflecting clinical monitoring activity, therapeutic interventions and comorbidity in patients affected by CHD.

Setting 317 general practices in 23 English primary care trusts (PCTs).

Data acquisition MIQUEST was used to interrogate computerised patient records. Data were extracted in the form of sex and age aggregated counts of patients meeting a range of extraction criteria.

Results The observed crude prevalence of CHD is 40.3 per 1000 (males 46.6, females 34.2). A variety of findings are presented relating to the treatment, monitoring and comorbidities of CHD. Significant and systematic gender inequalities are demonstrated to exist in the monitoring and treatment of CHD.

Conclusions Extraction of data from computerised patient records is a valuable and practicable method of generating information to inform clinicians and National Health Service (NHS) organisations. Systematic gender disparities exist in the care delivered to patients with CHD.

Summary points

- CHD affects approximately 4% of the population in England. A significant gender gradient exists with approximately 4.7% of males being affected and 3.4% of females.
- This study provides persuasive confirmatory evidence of previously demonstrated gender disparities in the monitoring and treatment of CHD. The data also strongly support the suggestion that such gender disparities are systematic in nature.
- The study provides evidence of feasibility and potential value of remote interrogation of computerised clinical records in primary care to provide detailed information about population health characteristics and clinical activity to both the clinical community and NHS organisations.

Keywords: clinical care, coronary heart disease, electronic patient records, gender inequalities

Introduction

The *National Service Framework for Coronary Heart Disease* (NSF) identifies coronary heart disease (CHD) as a major cause of preventable mortality and morbidity in England.[1] In addition, regionally and socio-economically determined variability in morbidity, mortality and intervention rates are described as 'unacceptable' and an explicit commitment is made to eradicating this 'postcode lottery of care'. The NSF sets a wide range of national standards, milestones, goals and performance measures through which the National Health Service (NHS) is required to respond to these challenges. The NSF explicitly requires NHS organisations to produce evidence of effective intervention.

Primary Care Information Services (PRIMIS) is a training and support service delivered to primary healthcare teams in general practice and to primary care trusts (PCTs) by a specialist team based in the Division of Primary Care at the University of Nottingham.[2] The objective of PRIMIS is to encourage general practice teams to make greater and more effective use of computerised patient records systems to support quality improvement in the delivery of clinical care. PRIMIS is configured on a cascade training basis and the resources of the service are made available to general practices through locally (usually PCT-) based information facilitators. To complement the training and support service PRIMIS also undertakes extraction, analysis and feedback of data from general practitioners' computerised records systems. Data extractions are configured to examine the quality of data and also to support comparative analysis against a range of recognised clinical guidelines.[3] In this latter category, PRIMIS has undertaken comparative analyses based on the recommendations of the NSF for CHD in January 2001 and May 2002 (a further extraction took place in 2003, and the results of this are in the process of analysis and interpretation).

This paper reports an analysis of data extracted from general practice computerised records systems in May 2002 for the PRIMIS CHD comparative analysis. The data reported reflect various aspects of the epidemiology and management of CHD.

Methods

Participants

A total of 317 general practices in 23 PCTs in England. Participating PCTs were widely spread geographically and included both rural areas and urban centres in the north, Midlands and south of England.

Eligibility criteria

All general practices and PCTs participated in the comparative analysis on a volunteer basis. No attempt was made to control for geographical location or socio-economic factors.

Data collection

Data were extracted from computerised patient records systems using the data extraction utility MIQUEST.[4] The data extracted were determined by a specification of criteria derived from the NSF for CHD and published on the PRIMIS website.[5] Data extraction was undertaken during May 2002 and involved interrogation of a total of 2 252 274 patient records. Data were extracted in the form of counts of patients meeting a range of extraction criteria broken down by sex and five-year age bands.

Analysis

Statistical analyses were undertaken using StatsDirect™ version 2.2.3. Where appropriate, direct standardisation of data was undertaken using the European standard population.

Results

Prevalence of CHD

Overall crude and standardised prevalence rates for CHD are presented in Table 1. The observed crude prevalence rate for CHD is 40.3 per 1000 (males 46.6, females 34.2) and the standardised rate is 31.3 per 1000 (males 40.3, females 23.2). Chi-square tests of the gender differences for both crude and standardised rates are both highly significant ($P<0.0001$). Data derived from the General Practice Research Database (GPRD) are also presented in Table 1 for comparison.[6] The data from GPRD refer to treated CHD and are therefore not strictly equivalent to the data obtained by PRIMIS, which includes all patients irrespective of their treatment status. Table 2 presents the prevalence data derived by PRIMIS aggregated to PCT level and demonstrates the high level (up to fivefold) of variation in crude prevalence rates between participating PCTs. Standardisation of these data results in a marked reduction in observed variation. These observations are further illustrated in Figures 1 and 2.

Table 1 Prevalence of CHD

		PRIMIS May 2002 (all CHD)			Key health statistics 1998 (treated CHD)	
		Subjects	CHD		Subjects	CHD
Absolute numbers	All	2 252 274	90 873		1 202 819	44 707
	Male	1 117 400	52 053		594 831	24 986
	Female	1 134 874	38 820		607 988	19 721
		Rate/1000	95% CI	P (χ^2)	Rate/1000	95% CI
CHD: crude rates	All	40.3	40.1–40.6		37.2	36.8–37.5
	Male	46.6	46.2–47.0	<0.0001	42.0	41.5–42.5
	Female	34.2	33.9–34.5		32.4	32.0–32.9
CHD: standardised rates	All	31.3	31.1–31.6		n/a	n/a
	Male	40.3	40.0–40.7	<0.0001	37.2	36.8–37.6
	Female	23.2	22.9–23.5		21.9	21.5–22.2

Table 2 Prevalence data for CHD aggregated to PCT level

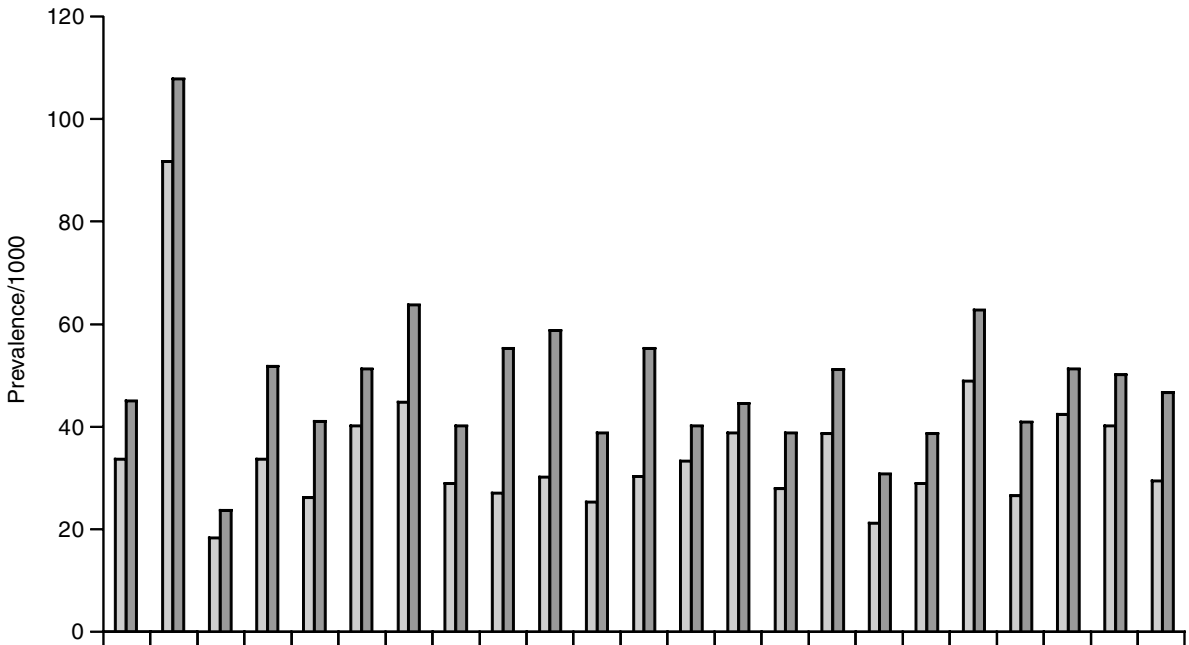
		Mean	Range	Interquartile range
CHD: crude rates	All	41.4	21.6–99.8	33.2–35.8
	Male	48.3	24.3–108.5	39.7–52.3
	Female	34.8	18.7–92.2	27.3–40.0
CHD: standardised rates	All	30.4	21.7–45.4	26.6–35.6
	Male	39.4	29.6–55.7	35.0–45.1
	Female	22.2	14.2–37.6	18.5–26.1

Treatment of CHD

Table 3 presents analyses of treatment interventions with statins and aspirin recorded during the 12-month period immediately preceding data extraction in the population with a record of CHD. Additional data are presented representing those patients with CHD but without a record of either intervention. Overall rates have been calculated using data pooled from all sources and the descriptive statistics reported (mean, range and interquartile range) reflect analysis of data aggregated at the level of each participating PCT. Evidence for statin treatment in the previous year was found in 45.4% of patient records (males 49.9%, females 39.5%) and evidence for aspirin prophylaxis (including evidence of self-medication by patients) in 68.8% (males 71.5%, females 65.1%). No data were extracted relating to contraindications or adverse reactions to either statins or salicylates. Patients for whom there was no evidence of either intervention represented 23.4% (males 20.4%, females 27.5%). All gender differences detected were present systematically across all 23 PCTs (as illustrated by Figure 3) and statistical analysis of these differences using chi-square tests consistently produced P values <0.0001. Further analysis of these data using the Mantel-Haenszel technique revealed no loss of statistical significance attributable to differences in age stratification between the two gender groups.

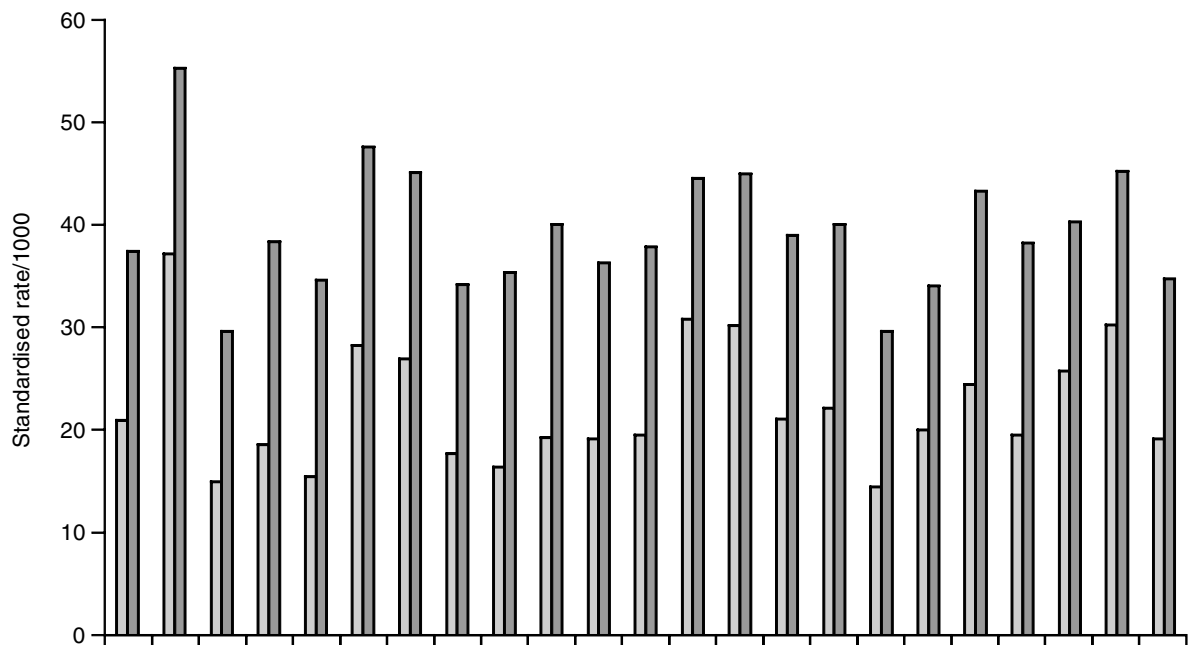
Clinical monitoring of patients with CHD

These data, all of which refer to records created in the 12-month period preceding data extraction, are summarised in Table 4: 74.0% (males 74.3%, females 73.7%, $P=0.07$) of patients have a recorded blood pressure reading; 35.0% (males 37.0%, females 32.3%, $P<0.0001$) have a record of body mass index; 49.7% (males 53.6%, females 44.5%, $P<0.0001$) have a serum cholesterol value recorded and 37.9% (males 39.8%, females 35.3%, $P<0.0001$) have had their smoking status recorded. Gender differences were again present systematically across all PCTs. Re-analysis using the



	PCT 1	PCT 2	PCT 3	PCT 4	PCT 5	PCT 6	PCT 7	PCT 8	PCT 9	PCT 10	PCT 11	PCT 12	PCT 13	PCT 14	PCT 15	PCT 16	PCT 17	PCT 18	PCT 19	PCT 20	PCT 21	PCT 22	PCT 23
Females	33.1	92.2	18.7	32.3	25.0	40.6	43.8	29.2	27.9	30.8	23.7	31.0	34.7	38.4	27.3	38.7	21.0	28.8	44.2	26.1	42.6	40.0	29.2
Males	45.5	108.5	24.3	52.7	41.5	52.4	64.2	40.0	47.2	48.7	38.2	47.5	39.7	45.7	38.8	52.1	35.3	38.7	62.3	40.3	52.3	51.5	43.8

Figure 1 Crude prevalence of CHD in 23 PCTs



	PCT 1	PCT 2	PCT 3	PCT 4	PCT 5	PCT 6	PCT 7	PCT 8	PCT 9	PCT 10	PCT 11	PCT 12	PCT 13	PCT 14	PCT 15	PCT 16	PCT 17	PCT 18	PCT 19	PCT 20	PCT 21	PCT 22	PCT 23
Females	20.7	37.6	15.1	18.6	16.5	27.6	26.1	17.5	16.4	18.6	18.5	19.4	30.9	29.6	21.5	22.5	14.2	20.0	25.3	19.4	26.0	29.7	18.9
Males	37.7	55.7	29.6	38.0	34.2	47.4	45.8	34.1	35.5	39.9	36.5	37.1	45.1	45.7	38.1	39.7	29.8	33.8	43.4	38.0	40.6	46.4	35.0

Figure 2 Standardised prevalence of CHD in 23 PCTs

Table 3 Recording of treatment offered to patients with CHD

n=90 873		Mean (data aggregated at PCT level)	Range (data aggregated at PCT level)	Interquartile range (data aggregated at PCT level)	Overall rate (%) (pooled data)	95% CI	*P* (χ^2)	*P* (Mantel-Haenszel)
Evidence of treatment with a statin (%)	All	45.3	27.6–55.7	40.6–50.5	45.4	45.1–45.8		
	Male	49.8	32.6–59.5	46.8–55.0	49.9	49.4–50.3	<0.0001	<0.0001
	Female	39.0	20.0–49.6	34.2–43.7	39.5	39.0–40.0		
Evidence of treatment with aspirin (%)	All	66.9	48.3–74.3	65.1–72.2	68.8	68.5–69.1		
	Male	69.4	49.9–76.3	66.6–75.0	71.5	71.1–71.9	<0.0001	<0.0001
	Female	63.5	46.4–71.7	60.8–67.8	65.1	64.6–65.5		
No evidence of treatment with either statin or aspirin (%)	All	24.0	17.6–38.1	21.2–25.1	23.4	23.1–23.7		
	Male	21.0	15.9–34.9	18.5–22.9	20.4	20.0–20.7	<0.0001	<0.0001
	Female	28.1	20.5–44.3	25.3–29.3	27.5	27.0–28.0		

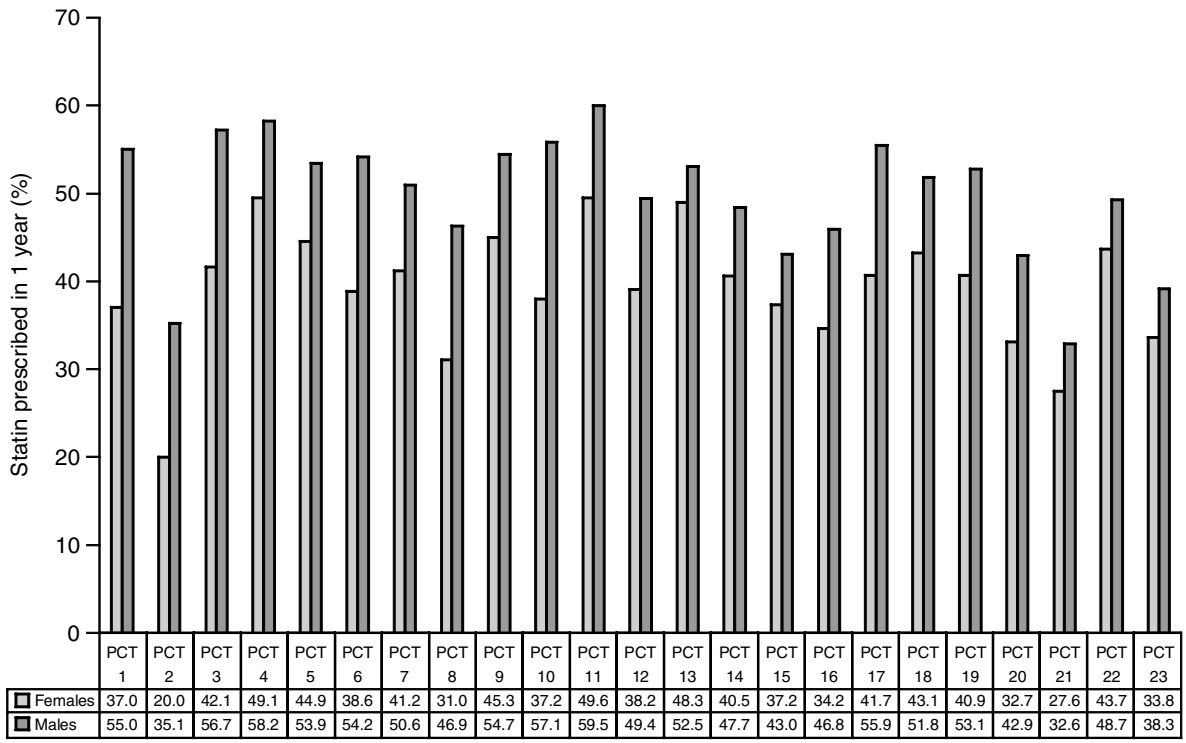


Figure 3 Evidence of treatment of patients with CHD with a statin in the previous year

Mantel-Haenszel technique revealed a probable age-stratification effect in the recording of blood pressure readings only.

Presence of comorbidities in patients with CHD

Analyses of comorbidity with CHD of heart failure, transient ischaemic attack or stroke disease, atrial fibrillation, peripheral vascular disease, diabetes mellitus and hypertension are detailed in Table 5. Heart failure was present in 11.0% (males 10.1%, females 12.3%, $P<0.0001$); transient ischaemic attack (TIA) or stroke disease present in 10.0% (males 9.6%, females 10.5%, $P<0.0001$); atrial fibrillation present in 8.4% (males 8.1%, females 8.7%, $P=0.0006$); peripheral vascular disease present in 3.9% (males 4.5%, females 3.2%, $P<0.0001$); diabetes present in 14.6% (males 15.3%, females 13.7%, $P<0.0001$) and

Table 4 Recording of clinical monitoring data in records of patients with CHD

n=90 873		Mean (data aggregated at PCT level)	Range (data aggregated at PCT level)	Interquartile range (data aggregated at PCT level)	Overall rate (%) (pooled data)	95% CI	*P* (χ^2)	*P* (Mantel-Haenszel)
Blood pressure recorded in last year (%)	All	72.1	37.7–85.6	68.4–79.9	74.0	73.7–74.3	0.07	<0.0001
	Male	72.0	37.9–85.6	67.7–79.5	74.3	73.9–74.6		
	Female	72.2	37.4–86.6	67.9–80.0	73.7	73.3–74.1		
Body mass index recorded in last year (%)	All	32.9	17.7–48.2	27.0–39.0	35.0	34.7–35.3	<0.0001	<0.0001
	Male	34.5	17.2–52.8	27.1–41.8	37.0	36.5–37.4		
	Female	30.8	18.3–41.9	24.5–37.3	32.3	31.8–32.8		
Serum cholesterol recorded in last year (%)	All	47.0	22.9–62.5	39.5–55.8	49.7	49.4–50.1	<0.0001	<0.0001
	Male	50.6	24.6–65.4	43.0–59.3	53.6	53.2–54.0		
	Female	42.0	20.4–58.0	36.1–51.9	44.5	44.0–45.0		
Smoking status recorded in last year (%)	All	35.6	18.3–45.9	31.6–42.3	37.9	37.5–38.2	<0.0001	<0.0001
	Male	37.1	19.9–48.6	31.4–42.8	39.8	39.3–40.2		
	Female	33.6	15.2–43.8	29.9–40.3	35.3	34.9–35.8		

Table 5 Comorbidities in patients with CHD

n=90 873		Mean (data aggregated at PCT level)	Range (data aggregated at PCT level)	Interquartile range (data aggregated at PCT level)	Overall rate (%) (pooled data)	95% CI	*P* (χ^2)	*P* (Mantel-Haenszel)
Comorbidity of heart failure (%)	All	11.1	3.4–20.0	9.4–12.6	11.0	10.8–11.2	<0.0001	0.03
	Male	10.2	3.9–17.7	8.8–11.4	10.1	9.8–10.4		
	Female	12.3	2.7–23.4	10.3–14.4	12.3	12.0–12.6		
Comorbidity of TIA or stroke disease (%)	All	10.0	6.4–17.0	8.4–11.0	10.0	9.8–10.2	<0.0001	0.0007
	Male	9.7	4.6–14.6	8.5–11.2	9.6	9.3–9.8		
	Female	10.6	6.2–20.6	9.1–11.4	10.5	10.2–10.8		
Comorbidity of atrial fibrillation (%)	All	8.4	5.5–11.1	7.2–9.7	8.4	8.2–8.6	0.0006	<0.0001
	Male	8.0	5.6–11.5	6.7–9.2	8.1	7.9–8.3		
	Female	8.8	5.3–11.6	7.8–9.8	8.7	8.5–9.0		
Comorbidity of peripheral vascular disease (%)	All	3.1	0.1–6.0	2.0–4.1	3.9	3.8–4.1	<0.0001	<0.0001
	Male	3.5	0–6.9	2.0–4.9	4.5	4.3–4.7		
	Female	2.5	0.2–4.8	1.8–3.2	3.2	3.0–3.3		
Comorbidity of diabetes (%)	All	15.0	12.0–19.3	13.5–16.5	14.6	14.4–14.8	<0.0001	<0.0001
	Male	15.6	12.5–20.6	13.8–17.1	15.3	15.0–15.6		
	Female	14.2	10.1–18.3	12.5–16.2	13.7	13.4–14.1		
Comorbidity of hypertension (%)	All	41.5	23.6–52.9	37.6–44.7	40.7	40.3–41.1	<0.0001	<0.0001
	Male	37.8	20.5–49.6	34.2–41.0	36.8	36.4–37.2		
	Female	46.7	28.6–56.3	43.1–50.3	46.0	45.5–46.5		

hypertension in 40.7% (males 36.8%, females 46.0%, $P<0.0001$). Analysis of these data using the Mantel-Haenszel test was notable only in relation to the presence of heart failure where the P value increased to 0.03.

The study team are aware of issues affecting the representation of peripheral vascular disease using Read codes and consider that the data extracted represents a significant underestimate of the true prevalence of this condition.

Strengths and limitations of this study

Data quality

No attempt has been made to evaluate the quality of the data that have been returned by practices. Measurement of the quality of clinical data without the benefit of detailed contextual knowledge (such as access to the source record and recording clinician) is, at best, an inexact science and the potential additional value to be achieved was felt to be low. However, previous studies have shown the accuracy and positive predictive value of data recorded in general practice computer systems to be very high.[7,8] Data published by PRIMIS have indicated that data quality in general practice systems is improving with time.[3]

Selection bias

Participating PCTs and general practices were recruited on a volunteer basis. In addition, because of the anonymous nature of PRIMIS comparative analysis activities, no information about the characteristics of the participating PCTs or their patients is known to the study team. Hence it has not been possible to eliminate or control for bias resulting from the self-selection of participants.

Sample size

The number of patient records interrogated represents over 4.5% of the English population.[9] The reliability and validity of the conclusions can be anticipated to be significantly enhanced as a result of the scale of the study.

Geographical spread

The study includes PCTs from a wide diversity of locations encompassing rural, semi-rural and urban locations in the north, Midlands and south of England. This degree of diversity is likely to contribute to the extent to which the study is representative.

Overall the study team consider that the data collected are highly likely to be representative of the population of England.

Discussion

In terms of the numbers of participating general practices and patient records interrogated, this survey represents one of the largest exercises of its kind ever to be undertaken. As such, despite the weaknesses outlined above, it can be considered to be an informative representation of the epidemiology of CHD and associated disorders encountered in primary care in England. In addition, it provides valuable insight into the response of English general practices to the service demands that CHD poses.

The prevalence of CHD reflected in these data is entirely consistent with that reported elsewhere, although other sources of similar data (such as the British Heart Foundation statistics database) are not directly comparable because they focus on denominator groups which are subsets of the total population, or, alternatively, they focus on treated CHD rather than CHD in its entirety.[7,10] Despite that limitation there is no aspect of the data presented here that suggests incompatibility with other sources of epidemiological data.

One of the most striking findings of this study is the pronounced gender disparities that are evident in both the treatment and monitoring of established CHD. Bouvy *et al.* in the Netherlands and Hippisley-Cox *et al.* in the United Kingdom (UK) have both previously reported this phenomenon in primary care.[11,12] The data presented here provide persuasive reinforcement of these earlier findings and strong evidence to support the suggestion by Hippisley-Cox of the existence of a systematic gender bias in the monitoring and management of CHD in the UK.

The data presented also demonstrate marked regional variations in the epidemiology of CHD. A fivefold disparity between geographical locations is demonstrated; this is, in part, accounted for by variation in demographic characteristics. It is highly probable that similar variations in demographic and socio-economic characteristics also exist at an intra-locality level. The magnitude of these variations will significantly complicate any attempt to compare clinical activity data at both inter- and intra-locality level. It is clear that, while this study demonstrates the utility of data extraction for the purposes of inter- and intra-locality comparisons, analysis of such data

requires considerable caution and full knowledge of the characteristics of all localities involved.

Conclusions

The use of data extraction techniques to access data from electronic patient records has been demonstrated to be a practicable approach to the generation of detailed information about population health characteristics and also about clinical activity in response to morbidity. This information is potentially of value to clinicians in pursuit of quality improvement and to healthcare organisations needing to monitor population health needs and healthcare activity.

CHD affects approximately 4% of the population with a significant excess in the male population. In contrast there is evidence of a significant systematic gender bias in favour of male patients in the monitoring and treatment of established CHD.

ACKNOWLEDGEMENTS

The authors would like to acknowledge the following who assisted in the preparation of this report: the PRIMIS facilitators and general practice teams in the participating PCTs; Carol Coupland, Senior Lecturer in Statistics, University of Nottingham; the PRIMIS Team at the University of Nottingham.

FUNDING

PRIMIS is funded by the NHS Information Authority.

REFERENCES

1 Department of Health. *National Service Framework for Coronary Heart Disease*. London: Department of Health, 2000. www.doh.gov.uk/nsf/coronary.htm
2 PRIMIS (Primary Care Information Services): www.primis.nhs.uk
3 Horsfield P. Trends in data recording by general practice teams: an analysis of data extracted from clinical computer systems by the PRIMIS project. *Informatics in Primary Care* 2002;10:227–34.
4 Hammersley V, Meal A, Wright L and Pringle M. Using MIQUEST in general practice. *Journal of Informatics in Primary Care* 1998;2:3–7.
5 CHD NSF Documentation: www.primis.nhs.uk/pages/Query_Documentation/CHD_NSF_Documentation.asp?om=m2
6 Department of Health. *Key Health Statistics from General Practice 1998*. London: Department of Health, 2000. www.statistics.gov.uk/downloads/theme_health/Key_Health_Stats_1998.pdf
7 Hassey A, Gerrett D and Wilson A. A survey of validity and utility of electronic patient records in a general practice. *British Medical Journal* 2001;322:1401–5.
8 Whitelaw FG, Nevin SL, Milne RM, Taylor RJ, Taylor MW and Watt AH. Completeness and accuracy of morbidity and repeat prescribing records held on general practice computer systems in Scotland. *British Journal of General Practice* 1996;46:181–6.
9 National Statistics Online: www.statistics.gov.uk
10 British Heart Foundation Health Promotion Research Group: www.dphpc.ox.ac.uk/bhfhprg
11 Bouvy M, Heerdink E, Klungel O, de Boer A, Stuurman-Bieze A and Leufkens H. Women with angina receive less antiplatelet treatment than men. *British Journal of General Practice* 1999;49:299–300.
12 Hippisley-Cox J, Pringle M, Crown N, Meal A and Wynn A. Sex inequalities in ischaemic heart disease in general practice: cross-sectional survey. *British Medical Journal* 2001;322:832–4.

ADDRESS FOR CORRESPONDENCE

Dr Pete Horsfield
Clinical Director
PRIMIS
Division of Primary Care
University of Nottingham
Floor 14, Tower Building
University Park
Nottingham NG7 2RD
UK
Tel: +44 (0)115 846 6420
Fax: +44 (0)115 846 6432
Email: pete.horsfield@primis.nottingham.ac.uk

Accepted August 2003